

BIO-OIL BRIEFING

**August 16, 2002
Concord, NH**

Hosted by:

**U. S. Department of Agriculture / Forest Service
U.S. Department of Energy / Office of Biomass Programs
New Hampshire Governor's Office of Energy and Community Services
Northeast Regional Biomass Program**

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NORTHEAST REGIONAL BIOMASS PROGRAM
Providing Direction to a Sustainable Future

Bio-oil Briefing
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Contents

Overview.....	1
Discussion.....	4
Presentations	
<u>Introduction to Bio-oil Production</u>	
National Renewable Energy Laboratories.....	P1
Natural Resources Canada.....	P2
<u>Technology Companies</u>	
DynaMotive Energy Systems Corporation.....	P3
Ensyn Technologies.....	P4
Renewable Oil International.....	P5
Magellan Aerospace Corporation.....	P6
Orenda Aerospace Corporation / Part 1.....	P7
Orenda Aerospace Corporation / Part 2.....	P8
Appendix A: Agenda	
Appendix B: Attendees	
Appendix C: Media Release / New Hampshire Office of the Governor / August 16, 2002	
Appendix D: New Hampshire Public Radio / WEVO 89.1 / August 20, 2002	
Appendix E: <i>Bio-oil's potential to be researched / Coös County Democrat / August 21, 2002</i>	

BIO-OIL BRIEFING – OVERVIEW

The Northeast Regional Biomass Program (NRBP), in conjunction with the U.S. Department of Agriculture (USDA) Forest Service, the U.S. Department of Energy (DOE) Office of Biomass Programs, and the New Hampshire Governor's Office of Energy and Community Services, hosted a briefing by private sector technology companies engaged in the development/sale of bio-oil production technology. The briefing was held on August 16, 2002, in Concord, New Hampshire at the Society for the Protection of New Hampshire Forests.

Bio-oil is a renewable "carbon neutral" fuel made from biomass resources. Interest in bio-oil production is driven in part by the perception that future bio-oil production facilities may provide a market for biomass feedstocks, such as forest residues and energy crops, and therefore can be a stimulus for rural economic development and provide a source of domestic energy production.

The Northeast Regional Biomass Program, with assistance from the New Hampshire Governor's Office of Energy and Community Services and Natural Resources Canada, primarily organized the briefing. The USDA Forest Service and the U.S. DOE Office of Biomass Programs provided financial assistance. Over 75 people representing key organizations in New Hampshire and the Northeast were invited to the briefing. The invitees included state and federal government officials, university researchers, forest products companies, and economic development professionals. A list of attendees is included in Appendix B. These organizations were selected because they were thought to be critical to any future potential demonstration of bio-oil production and market development. Their input would be valuable.

The New Hampshire Governor's Office of Energy and Community Services has received a \$99,451 grant from the U.S. Department of Energy to evaluate the environmental and economic potential for bio-oil in the state. The grant, which will be matched with \$100,000 in local contributions, will allow a thorough analysis of bio-oil technology and its suitability for New Hampshire. This briefing was organized by the Northeast Regional Biomass Program in an effort to assist the state in establishing baseline information and setting its feasibility study goals. The information provided at the briefing, including current information on the status of commercialization of bio-oil production technology, product markets, and the potential role of government in bio-oil development, will help New Hampshire to focus its resources on the most important unresolved issues. Other northeast states were also represented at the briefing, and the NRBP and the USDA Forest Service are working as partners to help ensure that lessons learned in New Hampshire are shared, and regional and national coordination and cooperation are enhanced.

New Hampshire's Governor, the Honorable Jeanne Shaheen, opened the briefing, which further emphasized the importance of what bio-oil could mean to the region. The Governor's remarks underscored the value of renewable energy to New Hampshire and the Northeast. Governor Shaheen stressed the urgent need to develop alternative fuels to help reduce the nation's dependence on foreign oil, provide a boost to New Hampshire's economy and reduce air pollution.

The briefing was organized in three parts:

- introduction to fast pyrolysis technology;
- presentations by technology companies; and
- attendee feedback on the presentations.

Stefan Czernik of the National Renewable Energy Laboratory and Ed Hogan of Natural Resources Canada, introduced fast pyrolysis technology. Copies of their presentations are included with this document.

After the introduction, each technology company gave a presentation, followed by a question and answer period. The four major North American technology companies, DynaMotive Energy Systems Corporation, Ensyn Group, Inc., the Pyrovac Institute, and Renewable Oil International, were invited to the briefing. Pyrovac declined the invitation and was replaced on the agenda by Magellan Aerospace / Orenda Turbine, which discussed its experience with using bio-oil in a turbine.

The goal of the technology company presentations was to provide meeting participants with a technology company's prospective on the commercial status of bio-oil production technology, current and future markets for bio-oil and co-products, and what role government can play in the technology commercialization and product market development. In an effort to help focus the presentations, each technology company was asked to address the following questions:

- Describe any commercial and/or demonstration projects of your company's bio-oil production technology. For commercial projects, how were they financed? For demonstration projects, how are (were) sites selected, how are (were) they financed?
- Discuss the impact of "economies of scale" for your bio-oil technology - is bigger better.
- What is the potential economic impact of future bio-oil production - in jobs created and energy displacement?
- What is the potential to produce multiple products from a single production facility, e.g., the biorefinery concept?
- What is the potential for co-location of bio-oil production facilities with other energy or forest product industries?
- Discuss, in general terms, the environmental challenges and benefits associated with a bio-oil product.
- What are the downstream research needs? How will future research reduce production costs and/or help build markets for bio-oil and co-products?
- What is the single most important step that either federal or state government can take to support commercialization of bio-oil?

Copies of each presentation are included with this document.

The briefing concluded with a facilitated session to receive feedback from the attendees. As stated above, the input of these key organizations will be very important in conducting the feasibility study and any subsequent technology demonstrations and bio-oil development activities. The attendees' comments were grouped into four categories:

- “what we heard”;
- questions that remain to be answered;
- recommended next steps that New Hampshire should take in its state feasibility study; and
- who are the potential collaborators.

A summary of the responses is included in this document.

The NRBP would like to acknowledge the contributions of the four technology companies that participated in the briefing. Their time and participation is greatly appreciated. It was generally agreed that this was the first briefing of its kind on bio-oil, and it was beneficial to all participants. The NRBP would like to acknowledge the financial assistance of the USDA Forest Service and the U.S. DOE Office of Biomass Programs. Finally, the NRBP would like to thank Joe Broyles and the staff at the New Hampshire Governor's Office of Energy and Community Services, and Ed Hogan of Natural Resources Canada, for their help in developing the program format.

BIO-OIL BRIEFING – DISCUSSION

What We Heard

1. Difference in laboratory results and commercialization claims:
 - Viscosity change is a problem – lab claim;
 - Viscosity change is not a problem – commercialization.
2. Bio-oil production technologies are mature.
3. For many, bio-oil is still a mystery: what it is, what state of development. Need better communication/explanations. There are challenges. Need for standards of quality and physical/chemical properties.
4. Desirability of an industry association to promote bio-oil, establish standards, address issues common to the various companies.
5. Large production facility provides economy of scale, but must consider appropriateness, niche market size. Production is scalable.
6. In determining economic validity, need to look at whole value chain from feedstock costs to production, to niches/locality/markets. Some steps in chain may cost, while others bring in revenue. Ownership of whole value chain can make for profitability.
7. There can be a gain in efficiency via integration of products.
8. More testing has been done than the public is aware.
9. Incentives are needed. But others claim economics work in the right niches.
10. The industry is moving out of labs and is now in the gap between labs and commercialization.
11. Feedstock availability and cost are critical – breakeven feedstock cost not clear.
12. What are emissions profiles for production and use: SO_x, NO₂ (CO₂?) – particulates, hydrocarbons? This information is apparently available now.
13. Bio-oil has been in use since 1989, a multi-use commercialization.
14. Can emulsify bio-oil with hydrocarbons. Not miscible without emulsifiers.
15. Bio-oil is readily transportable; easily pumped and stored – compared with wood.
16. Co-firing with diesel is being done (testing stage?)
18. Degrades over time – what storage capability/conditions are needed? (standards issue again)
18. Bio-oil can run in reciprocating and other engines.
19. Coatings for combustion turbines protect against corrosion and erosion simultaneously.
20. Polymerization of bio-oil may occur if combustion is not shut down properly.
21. Energy balance issue (2nd law). That is, how to justify consuming some of the energy from wood feedstock to operate the pyrolysis process, leaving less energy in the bio-oil?
22. Handling, odor, safety issues are the same as or less than for petroleum.
23. Higher value uses are more economically advantageous than burning bio-oil for energy.
24. Moderately low energy content/gal (about 50% of #2 oil energy content).
25. Bio-oil is not the same as biodiesel; this needs to be clarified in the Feasibility Study.
26. Less costly than biodiesel.
27. Not literally “oil” – make clear.
28. Biogas from pyrolysis can be burned to provide heat for ongoing pyrolysis.
24. Combined cycle efficiency (using turbines) is greater than for conventional boiler that might burn wood (energy loss in pyrolysis of wood may be offset by greater efficiency).
25. Early applications will be boiler fuel and combined heat/power (CHP); a chemical industry later. Just beginning to see chemical industry potential.
31. Char “byproduct” of pyrolysis is marketable.

Questions

1. What % of the wood pyrolysis industry is here today? (75% of North American)
2. Would various technologies (scale, etc.) fit into NH context? Or how would it – relative to location of resource, markets, species (e.g., white pine) → variations in H₂O content, etc.
3. Definition of “wood waste” (when is a chip not a chip)? Distinguish forest “waste” from construction and demolition waste (CDW) and pallets.
4. What does “wood waste” compete against? Question refers to other energy sources??
5. What is the actual cost of security to import crude oil? Don’t replicate this with bio-oil.
6. Are people willing to pay for security? (In possibly higher cost/Btu of bio-oil vs. #2 e.g.?)
7. Has there been any study of residential markets?
8. What markets exist and how large?
9. What barriers to market entry, e.g., lowered crude oil cost?
10. What is known about bio-oil’s chemical and physical properties?
11. Could that knowledge be used to fractionate bio-oil into constituent chemicals?
12. Are there heavy metals and dioxin issues with bio-oil?
13. How do bio-oil opportunities compare with ethanol and biodiesel opportunities?
14. Trucking in cold weather- does bio-oil thicken?
15. Is there a potential feedstock inventory for New Hampshire? (Yes.)
16. What are the environmental/safety issues, for transport, e.g., relative to petroleum products?
17. What are the requirements regarding these issues?
18. What is the cost to convert wood to chips for pyrolysis? (In energy or money or both?)
19. What is cost to convert existing wood-fired power plants to bio-oil?
20. Is it more feasible to make and use bio-oil at same site (Co-location) or to make it here and ship it to some other use site?
21. Is power generation a good option?

Next Steps (Include collaboration & partnerships)

1. Defining market and applications – risk issues, cost/ton.
2. Feedstock providers can share in \$ as part of process with higher value products; (co-ops!!)
3. The Governor's Office of Energy and Community Services (ECS) should send its grant \$ to the University of New Hampshire to examine physical and chemical properties of bio-oil.
4. Establish a North American pyrolysis network.
5. Hands on observation of production, testing, combustion processes.
6. Organize a committee to assemble a grant proposal to DOE: scope of work, cost sharing, etc., headed by ECS, to study (commercialization? properties?).
7. Characterize New Hampshire infrastructure, combined heat/power (CHP), transport, etc. Look at niche applications & specific needs, opportunities.
8. Product acceptance: Need a self-contained presentation on production and use of bio-oil. If NH goes forward with a demo project, there will be a real need for such a presentation.
9. ECS should study market feasibility.
10. Approach a lumber company to set up a kiln drying demonstration.
11. Quantify societal benefits; this would determine any potential role of government.
12. Assemble key known information.

Collaborations

1. States (relative to specific industry mix) look at added value products.
2. Northeast Regional Biomass Program, Governor's Office of Energy and Community Services, New Hampshire Department of Resources and Economic Development; Northeast land grant state Universities – NY, NH, VT, ME (may be in place already?)
3. Sun Grant Initiative
4. New Hampshire Timberland Owners Association – Society for the Protection of New Hampshire Forests
5. Public Service New Hampshire (or appropriate companies within Northeast utilities)
6. Wood products manufacturing groups
7. Massachusetts Division of Energy Resources - Howard Bernstein
8. Mount Wachusett Community College
9. Wood products industry
10. U. S. Department of Energy
11. Industry of the Future
12. Berlin Economic Development Company
13. Massachusetts Technologies Collaborative (Renewable Trust Fund)
14. Connecticut Clean Air Fund
15. 3 pyrolysis companies (form an industry association)
16. Massachusetts Department of Environmental Management sawmill project – Gordon Boyce